A

MEMOIR

ON THE

HISTORY and THEORY

OF A

MACHINE

FOR

CLEARING ROADS FROM MUD.

TO WHICH IS ADDED,

The Paper, containing a Description of the Machine, the manner of its Operation, and Testimonials of its Utility,

WHICH WAS SENT TO THE

SOCIETY

For the Encouragement of

ARTS, MANUFACTURES, AND COMMERCE.

By JOHN WINTERBOTTOM, M. D.

London:

Printed by C. and W. Galabin, Ingram-Court, Fenchurch-Street.

1805.

ADVERTISEMENT.

THE following Memoir, being entirely elementary and illustrated by diagrams, will require the patience and the indulgence of the philosophical reader: but, as it also professes to proceed upon certain and acknowleged principles, it was judged to be necessary, that the facts, on which those principles are founded, should be fully and accurately stated, for the information of those who are unacquainted with subjects of this nature.

Newbury, April 28th, 1803.

A

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MACHINE

For clearing Roads from Mud.

SECTION I.

In answering the question, to which the inquiries of several of my friends have frequently been directed, concerning the principle upon which my Machine was constructed, I shall, with as much accuracy as possible, communicate the ideas which occupied my mind when engaged upon that subject, and which may serve as a faithful history of the invention of the Machine: hoping that these observations may be of use, hereafter, to any

one

one who should be inclined to improve upon my plan.

I confess that I was first led to direct my attention to this subject, from its having been proposed by the Society of Arts in the month of June, 1802; and I ought to add, that the very wet summer of that year, when the roads were worse than I ever remember them to have been at that season, contributed, in a great measure, to recall the subject frequently to my consideration.

I at this time occasionally amused myself in contriving various sorts of instruments, which by mere mechanical force might be applied to the removal of mud, considering it as a COMMON MASS OF MATTER; and it was only while I was thus frequently revolving the subject in my mind, that I happened particularly to notice the passage of a large stage-waggon through a road full of mud; where

where I observed the track made by the wheels, which were nine inches wide, to be almost instantly reduced to half that extent, from the mud on each side falling in, and filling up the space just passed over. It was this circumstance which led me to view the subject in what I thought a new light, and I thence began to consider mud as a fluid, varying in consistence according to the quantity of water with which the earth, gravel, &c. are united; as lava, flowing from a volcano, varies in fluidity by different degrees of heat. I therefore hoped to accomplish my project, if a machine could be so constructed as to act partly upon mechanical, and partly upon hydrostatical, principles.

Having supposed mud to be a fluid, which it certainly is, as much as honey, tar, &c. can be so considered; and as it perfectly agrees with the definition of a

fluid

fluid which has been given by Sir Isaac Newton, that IT IS A BODY YIELDING TO ANY FORCE IMPRESSED, AND WHICH HATH ITS PARTS VERY EASILY MOVED ONE AMONG ANOTHER; I concluded that it must also be subject to the general laws of fluids.

I was next led to consider, that, on these principles, the mud might possibly be made to be one of the instruments of its own removal; and I now called to mind the phenomena, which I had often observed, in a stream of water flowing with violence against a board, placed across the greatest part of the stream, and perpendicularly to the horizon; and the most remarkable appearance in this process was the rising of the water against the board, which will always be found at a height proportional to the force with which it had been moved: of

which

which observation a clearer notion may be formed by the figure No 1, Plate I.

This phenomenon is to be accounted for from the INERTIA or VIS INERTIÆ of matter; that passive nature by which bodies never move of themselves, nor, when in motion, ever stop without some external resistance. From this fact is deduced the first law of motion, or rather the first law of mind respecting motion, that EVERY BODY PERSEVERES IN A STATE OF REST, OR OF UNIFORM RECTILINEAL MOTION, UNLESS AFFECTED BY SOME MECHANICAL FORCE; and on the truth of this proposition depend the chief parts of the science of natural philosophy.

"The VIS INERTIÆ of matter is no where more conspicuous, than in the sudden motion of a vessel full of water along a plane, upon which the liquor

at first seems to move with a direction contrary to that of the vessel; for, rising against the posterior side, it will commonly dash over. Not that there is really any such motion impressed on the liquor; but that, by the VIS INERTIÆ of matter, (the water endeavouring still to continue in a state of rest,) the vessel cannot in an instant communicate its motion to it, it not being a consistent or fixed body, like itself, but a fluid: the liquor, therefore, remains for a small time in its first state of rest, while the vessel makes forward, and therefore seems to move a contrary way. But when the liquor has the motion of the vessel fully communicated to it, and begins to move with a velocity equal to that of the vessel, they then proceed very quietly together. Yet even then, should the vessel be suddenly stopped, the liquor, endeavouring to continue its

its acquired motion, will dash again over the other side of the vessel."*

Keeping still in view this example of water, I farther reflected on the common appearances exhibited by a river, when changing its course at a right angle from its actual direction: which may be illustrated by the figure, No 2, Plate I.

Here a similar rising of the water may be conceived against the bank of the river BC, to that which we have seen take place against the board in the figure, No 1. The form of the stream will be manifestly changed in a certain manner along the bank BCD, but, when it arrives at E, we believe it to have again acquired the form and velocity which we supposed it to have had at A.

 The

* Clare on the Motion of Fluids, p. 123.

The chief appearances, however, which deserve our attention, are the changes which have been wrought upon the stream in passing along those parts of the bank marked BCD. The water will here be, as we have already mentioned, forced up against the bank from the angle at B to C, and, in consequence of this impediment, it will lose a great portion of its velocity. It will now become, where it is heaped up, almost motionless, as I have frequently observed it; yet, notwithstanding the continual accession of water flowing in, it will not in general rise above a certain and determinate height; it must, therefore, find somewhere a ready out-let, and we shall accordingly observe it to discharge itself in a strong current, which will be particularly conspicuous at a moderate distance from the bank, between C and D. This

greatly-

greatly-increased and newly-acquired velocity can only be ascribed to that well known property of fluids, by which they have a powerful tendency to find their level after having been forcibly raised above it; and this property is to be observed in fluids in proportion to their mobility, or disposition to be easily moved: this tendency therefore to find its level, after such elevation or accumulation, is the power which enables the water to recover the velocity that it had lost by beating against the bank, and we must consider it as the real cause of the new motion imparted to the stream. It need only be farther observed, that, after the water has passed by D, it will gradually diffuse itself across the river, and again appear at E in the same state as it was in at A.

Having

Having attentively reflected upon all the preceding observations, I at length ventured to draw the following conclusion; which being granted, I might flatter myself that I had already made no inconsiderable proficiency in attaining the real object of my pursuit: that, as it may be justly inferred that similar or equal motions will always, under like circumstances, be produced by similar or equal forces, so it may be conjectured, THAT THE EFFECT WILL BE THE SAME, cæteris paribus, WHETHER A BOARD BE IMPELLED AGAINST A BODY OF STILL WATER, OR WHETHER THE WATER BE MADE TO FLOW AGAINST A BOARD AT REST.

It was this supposition of the mud upon roads being considered as a river at rest, and afterwards to be put in motion, that led to the completion of my scheme; or, if I may be permitted

to

to uſe the words of another, when speaking of my own humble labours, I shall say, with M. l'Abbé Vicaire, " C'est donc cette pensée qui nous a mis sur les voies pour arriver au développement de l'économie de nôtre plan, et pour en découvrir l'ensemble. Nous n'y sommes parvenus qu'après de longues et sérieuses méditations; mais enfin nous y sommes parvenus, du moins nous le croyons, sur la foi des preuves solides que nous en avons données. Ce développement a jeté tout-à-coup une vive lumière dans toutes nos réflexions, et a dissipés les embarras que nous éprouvions au commencement."*

I was farther confirmed in my expectations of the effects to be produced by the pressure of a board, which should be moved against a body of still water, from the following observation: " In

* Exposition Raisonnée de l'Enéide de Virgile. Paris, 1787.

"In the theory of motion, rightly understood, the same laws, that serve for comparing, compounding, or resolving, motions, are observed likewise in pressures; that is, the powers that generate motion, or tend to produce it: for, forces are nothing else but the sum of such pressures, accumulated in the body in consequence of the continued action of the powers for a finite time; and pressures are considered as infinitely small forces, or as the elements from which the forces are produced: and it adds no small beauty and evidence to this theory of motion, that both observe the same laws."*

I now applied these principles to the construction of a machine, and therefore represented to my mind a scraper, placed in like manner perpendicularly to

* Maclaurin's Account of Sir Isaac Newton's Philosophical Discoveries, p. 130.

to the horizon, and not at a right angle with the road, as in the instance of the river above given, but in an oblique direction, see the figure, No 3, Plate I. to facilitate a passage or out-let by one extremity of it only; (as well as for other advantages, which will be explained hereafter, to be derived from the obliquity itself;) and I afterwards imagined it to be moved against a body of mud, which I conceived would rise in front of the scraper, like water in the examples already mentioned, but with more durable or sensible effects,* according to the degree of its density and tenacity; for, we must understand it at all times to possess less mobility than pure water.

* The sensible effect of mud, in comparison with water, may be proved by the observation, "that the VIS INERTIÆ is always proportionable to the density of bodies, or the quantity of matter they respectively contain." Clare on the Motion of Fluids, p. 124.

It must likewise be expected, from the continued motion of the Machine, that, as one portion of the mud rises, more will be forced up in perpetual succession; it will, however, be gradually retarded in its progress upwards by the power of gravity, (for, as heavy bodies are uniformly accelerated by the power of gravity in their descent, it is plain that they must be uniformly retarded by the same power in their ascent,*) till it at length arrive at its MAXIMUM. The mass of mud, having thus attained its highest elevation, may be conceived to become, for an instant, stationary, as in a well-adjusted balance; but the progressive motion of the Machine, acting upon the mud so raised up, will soon disturb the equilibrium; the mud will therefore be pushed forwards, and immediately be disposed to

* Ferguson's Lectures on Mechanics, Hydrostatics, &c.

to descend by its own weight. The more watery parts will now appear to run off in a full stream, as from a spout, in consequence of their great mobility, like the current of the river above-described, at its passage between C and D in the figure, No 2; but those which are heavy and of thick consistence can only pass off in regular or spiral folds, occasioned by the obliquity of the scraper, as will more particularly be shewn in the following Section.

SECTION II.

WHAT has been already advanced, in the plainest but most general terms, I at first thought would be deemed sufficient to explain or elucidate the peculiar opinions which I have had on this subject; but I afterwards judged it proper to enter into several particulars in this place, that I may not incur the imputation of entertaining visionary notions of the MODUS OPERANDI of the machine; to which, from the obvious simplicity of its construction, I might perhaps be liable. It will, therefore, be my endeavour to shew, in a cursory way only, that this theory of the action of the machine, especially on the more heavy parts of the mud, is susceptible of demonstration according

according to the strictest principles of geometry, or rather of rational mechanics;* and, from such investigation, I have reason to believe that the subject will be found to be more curious and interesting than at first sight might have been expected.

I have already sufficiently shewn how the mud, as a fluid, when previously at rest, will, by the first law of motion, be made to rise against the board of the scraper, immediately upon its being put in motion; and I have illustrated this fact by the familiar instance of a vessel full of water, when suddenly moved from a state of perfect rest. I may here farther remark, that the observations which have already been related, respecting the appearances exhibited

* "Rational Mechanics is the science of motions resulting from any forces whatsoever, and of forces required to produce any motions, accurately proposed and demonstrated." Sir Isaac Newton's preface to the Principia.

hibited in the figure, No 1, Plate I. of the rising of a stream of water against a board or other impediment, may be proved, as well as confirmed, by a like phenomenon, and from the same cause also, viz. the INERTIA of matter, recorded by Sir Isaac Newton, in the account of some experiments made by himself to distinguish absolute from relative motion. "If a vessel, hung by a long cord, is so often turned about that the cord is strongly twisted, then filled with water, and held at rest together with the water; afterwards, by a sudden action of another force, it is whirled about the contrary way, and while the cord is untwisting itself the vessel continues for sometime in this motion; the surface of the water will at first be plain, as before the vessel began to move: but the vessel, by gradually communicating its motion to the water,

will

will make it begin sensibly to revolve, and recede by little and little from the middle, and ASCEND TO THE SIDES OF THE VESSEL, FORMING ITSELF INTO A CONCAVE FIGURE, (as I have experienced;) and, the swifter the motion becomes, the higher will the water rise, till at last, performing its revolutions in the same time with the vessel, it becomes relatively at rest in it."*

In entering into a minute detail or nearer view of this matter, I shall distinctly trace a particle of mud through its whole progress, as acted upon by the scraper; since it is always by the most simple phenomena that we can investigate with accuracy the laws of nature.

I may now therefore observe, that the direction of a particle of mud will, by

* See Motte's Translation of the Principia, vol. i. p. 15. Edition 1729.

by its INERTIA, on the first motion of the machine, be upwards, or PERPENDICULAR, against the board of the scraper, (as exhibited in the line AB of the figure, No 4, Plate I.) because the board is placed perpendicularly to the horizon; but, during each successive instant of its ascent, it will likewise be operated upon by a power in a TRANSVERSE direction, AC, occasioned by the progressive motion of the Machine: the particle will therefore obey neither of the powers singly, but, by the composition of forces, it will move in the diagonal, A D, of a parallelogram, which may be supposed to represent the forces.*

This

* This proposition is so well established, and is of so universal application in Natural Philosophy, that it has long been considered, by Professor Robison, as the foundation of a law of motion.

See Outlines of Mechanical Philosophy, 8vo, Edinburgh, 1781. See, also, the 1st and 2d Corollaries to the third law of motion, in Sir Isaac Newton's Principia.

This diagonal motion may be considered as the true direction of the particle of mud, and may be compared to that of any projectile body, as of a stone or bomb, when thrown obliquely upwards, but which is known by the action of gravity, as a continual deflecting force, to describe nearly a parabolic curve; for, it was long ago shewn, by Galileo, that, when a stone projected moves in a parabola, its deflection into that curve, from its rectilineal path, is occasioned by the gravity of the stone towards the earth; so, in the present case, the motion of the particle of mud will in like manner be curvilineal, as represented in the figure, No 5, Plate I.

The particle of mud, in thus ascending along the line A, will be uniformly RETARDED in its rise till it arrives at C, where it will have attained

its greatest elevation or MAXIMUM; it will thence descend, with an uniformly ACCELERATED motion, along the line B.*

There is nothing, surely, which can excite our surprise in this appearance of a parabola, exhibited by a particle of mud, when we consider that the curvilineal motion of bodies is perhaps the most

* The retardation and acceleration in projectiles, effected by the power of gravity, may be understood by the ascent and descent of bodies; as, for instance, in the motion of a stone thrown PERPENDICULARLY upwards, which we shall suppose to ascend for five seconds, and during that time its motion will be gradually and uniformly RETARDED. In the first second it will move nine rods, for example; in the second, seven rods; in the third, five rods; in the fourth, three rods; and in the fifth, one rod: here, at its MAXIMUM in height, it will stop for an instant in a state of perfect REST; but it will afterwards descend with a motion gradually ACCELERATED, the order just now given being inverted, that is, in the first second it will move one rod; in the second, three; in the third, five; in the fourth, seven; and, in the fifth, nine.

The velocity of a body, ascending or descending in a right line, in the several places through which it passes, as also the time in which it will arrive at any place, are GEOMETRICALLY demonstrated, in the clearest and most satisfactory manner, by Sir Isaac Newton, at Prop. 39, Problem 27, of the first book of the Principia.

most general affection of matter that we are yet acquainted with: and on this occasion it ought also to be remarked, that, when fluids are projected in various ways and by different kinds of instruments, they have been found to describe nearly the same course as solids; if, however, "bodies near our earth were to be projected in an unresisting medium, according to the doctrine of Galileo, their motion would be performed exactly in the parabola. But, as all our observations must needs be made on bodies moving in the air, the curve they really move in falls considerably short of that line which they would otherwise have described; and especially towards the end of their motion, when the projectile force is much impaired by the resistance of the air. Nor is this deviation inconsiderable, even though the projected bodies be of lead or iron,

especially if they are thrown far; but the difference is still greater if the projected body be so light as water."

"Sir Isaac Newton found that a horizontal JET D'EAU, which should have gone to the distance of forty inches in a parabola, upon trial reached only to thirty-seven; the resistance of the air taking off a thirteenth part of its projectile force."*

It only remains that I should point out, in continuing to trace a particle of mud in its progress, the advantages which I have supposed are to be derived from the oblique position of the scraper, in forming an angle of one hundred and twenty degrees with the line of draught. I conceived, in the first place, that, during the motion of the Machine, each particle of mud would be operated upon by the scraper, the moving

* Clare on the Motion of Fluids, p. 121.

moving power, in the direction of lines forming right angles with it, and therefore that each particle would describe a parabola in that direction.

The figure, No 6, Plate II. must now be referred to, where it is supposed that a particle is begun to be acted upon at the upper end of the scraper, and where it will be found to describe a parabola, whose range is represented by the line AB; and it must here be remarked, that, by the time that this arch is completed, the Machine will have advanced along the dotted line from C to B, which place of B will now be represented by C, (on the supposition of the Machine having thus far advanced;) and from this place a second parabola will then be described with the range CD, the Machine in the mean time advancing along the dotted line from E to D, which place

of

of D will now be represented by E; a third parabola will again be formed with the range EF, and thus, in regular succession, till the particle shall have disengaged itself entirely from the Machine, at the lower extremity of the scraper, by describing the parabola with the range YZ, which letter Z, as may be observed in the figure, is without the course of the Machine.

I have here completely exhibited a single particle as passing along the whole length of the scraper, with a rotatory and spiral motion; and a succession of particles may be easily supposed to move along in the same course, as water is made to flow through the Screw-Engine of Archimedes, which a part of this figure may be shewn to resemble in several respects, but chiefly as being a cylinder, in which the small lines and dotted lines exactly trace out the

spiral

spiral groove or tube in that machine. By means of this illustration, a more accurate idea may be formed of the manner in which I conceive the Machine to act, than from the description alone which I have given.

But the real extent of the powers of the Machine is still to be explained; for, it must be obvious that it does not only act upon a single particle, or a succession of particles, at one and the same time, as in the instance already given, but upon an immense number of particles, which are put in motion upon the whole space of the road over which the Machine is passing, and which may be supposed to meet the scraper as the extremities of so many parallel lines, whose direction is accurately marked out by the dotted lines of the figure, No 6, Plate II. When, therefore, the portion of mud A shall,

as

as by the former process, be arrived at C, it will, from the situation of the Machine in respect of the road, also be met by the same quantity of mud as was at A; C must consequently be estimated as equal to two. When C likewise shall have arrived at E, it must be considered as equal to three; and thus in a regular and increasing arithmetical series.

It may farther also be shewn, that as, on the repetition of every parabola, each successive one must receive continual increments of matter, so the extreme height to which the mud will rise against the board of the scraper, and the extent of the range of each parabola, will be found, respectively, to be proportional, in a geometrical ratio which might be assigned, to the quantity of matter which has been put in motion.

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We shall accordingly observe, that the general appearance of the mud, while operated upon by the Machine, may be compared to that of a cone rolling horizontally on the ground, of which the outline may be comprehended by the figure, No 7, Plate II. and in which the succession of one class of particular operations may be distinguished, with respect to their differences, by the lines which represent the ranges of the several parabolas.

It is not necessary for me, on this occasion, to mark out the respective lines by which the extreme height of the mud, raised against the different parts of the board of the scraper, is to be determined; since the various lengths of those lines may be inferred from the preceding observations.

This conical appearance of the mud is the effect, which, as from theory I

anticipated, so I expected, with some confidence, that it would be produced; and it afforded me great satisfaction to see it clearly and strikingly realised in my first experiments on the public roads, when I took pains to point out, to those gentlemen who did me the honour to attend, the regular and spiral folds in which the mud was turned over, and at length left behind, by the Machine.

Such were the foundations of those speculations upon which my Machine was constructed; and, through the whole of my inquiries, I have uniformly argued from things known to other things that resemble them, being sufficiently aware that no theory can be maintained in which the principles are not

not some known or existing laws of nature. I have, indeed, altogether proceeded SYNTHETICALLY, by inquiring into the effects which might be expected to arise from causes universally established; and in the conclusion of this investigation I have, in some measure, been gratified, as well as by the success of my experiments; the result of which led me to advert with satisfaction to the following observation of a very intelligent writer,* in approbation of my proceedings: that "the successful application of science to the production of effects is the last and most convincing evidence of its reality, or of the truth of its principles."

I am, indeed, far from pretending to assert, that the exact FORM and SIZE of the Machine which I have used

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* Adam Ferguson, L.L.D. late Professor of Moral Philosophy in the University of Edinburgh. See Principles of Moral and Political Science.

are incapable of improvement, because I am fully sensible that perfection, in this as in most other things, cannot be attained but by successive trials and careful observation, whence various alterations will undoubtedly be suggested; and that experience alone, which is the grand corrector of errors, must determine at last the choice of what is best. It is notwithstanding very reasonable to believe, that the most important improvements are to be sought for, with the greatest probability of success, in a farther consideration of those principles which have so happily succeeded, however unskilfully they may have been applied, on the present occasion.

I have now completed my design, which was to disclose, without reserve, the principles upon which I acted, and which led to the invention of this Machine.

Extract from the XXIst Volume

OF THE

TRANSACTIONS

OF THE

Society for the Encouragement of

ARTS, MANUFACTURES, and COMMERCE.

The SILVER MEDAL of the SOCIETY, or TWENTY GUINEAS, at his option, was this session voted to Dr JOHN WINTERBOTTOM, of Newbury, in Berkshire, for a MACHINE for clearing turnpike and other roads from Mud.

Dr Winterbottom preferred the honorary reward of the Society.

The following account was received from him, and an engraving of the Machine, with a description thereof, hereunto annexed.

A model of this invention is placed in the Society's repository.

AN

Account

OF A

MACHINE

For clearing great roads from mud.

Description.

In a description of this Machine I shall briefly notice the five principal parts of which it is composed, the frame, the scraper, the chain, the sledge, and the pole; because a very accurate model accompanies this paper, made upon the usual scale of one inch to a foot.

The FRAME, (see Plate IIII. figure, No 8,) consists of two pieces of timber, AA, which at one extremity are formed into a pair of shafts, BB, and at the other

other are strongly united by three transverse pieces, CDE.

The SCRAPER, F, is placed under this frame-work, in an oblique direction, at an angle of thirty degrees, between two of the transverse pieces, CD, and consequently forms an angle of one hundred and twenty degrees with the line of draught. By this position of the scraper, the Machine, when used, actually clears itself from the mud as fast as it is collected, and removes it into a heap on one side, after the manner of a plough.

The CHAIN, G, is connected with a piece of iron-work, H, which projects from the lower end of the scraper; for, here additional power is required, as the whole body of the mud, which has been collected, must pass off by this extremity: some advantage has also been

been gained, by making this end of the scraper shorter than the other.

The SLEDGE, II, is constructed upon the upper part of the frame, that, by inverting the Machine, it can be transported, without injury to the scraper, over the most rough and stony roads or pavements, to those places where its use is particularly required.

The POLE, K, which is moveable, serves the purpose of a rudder, that, when the Machine happens to be forced by any great weight of mud, or solid body of earth, &c. from its proper direction, it can be easily restored to its former position: and it may also be observed, that the moderate pressure of the hand upon the pole tends to make the Machine steady, and therefore causes it to work to more advantage. In the model, the pole is made only ten inches long, instead of fifteen, that

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it might occupy less space in the box. The plates in front of the scraper, and upon the sledge, are made of cast iron.

Operation.

For the operation of the Machine two men and four horses are required; one man to drive the horses, and another to take the management of the pole and the direction of the labour to be performed. The horses are to be worked double, as commonly practised; two being employed to draw by the shafts, and two by the chain above-described. But the manner of using the Machine will be best understood by the following sketch: Plate IIII. figure, No 10.

The first progress of the Machine, marked No 1, commencing from the arrow-mark, will remove the mud in a line to the right; the first return, No 2, will remove another part of it to the left. The second progress, No 3, will take up what was left by No 1, besides the quantity which is upon the space now to be passed over, and will remove it all to the right; the second return, No 4, will operate in a similar manner with regard to No 2, and remove that to the left. Thus, by four lengths, more than twenty feet wide of a road can be cleared; and this has been frequently performed in the presence of several persons. The number of lengths may be increased, at pleasure, according to the width of the road.

In the neighbourhood of London, where there is incessant travelling, it would be adviseable to use two Machines

chines at the same time, one immediately following the other, as in Nos 1 and 3, which will leave a space sufficiently wide for the largest carriage to pass, without disturbing the mud already scraped up.

There is one advantage in the operation of this Machine worthy of being noticed, which is, that by the use of it the road is made more even and smooth, the small holes being filled up by the more solid parts of the mud; whereas, when roads are scraped, in the usual way, by hand, all the irregularities are increased, and become the future deposits of water: and it is universally known that these puddles, as they are called, are the chief cause of the destruction of roads.

It has been observed that stones are sometimes forced up by the Machine, but it appears to be those only which

project in such a degree as to be dangerous to the traveller, and which require to be broken for the more effectual mending of the road.

I can say nothing concerning the effect of the Machine upon dusty roads, having had no opportunity of trying it at that season of the year: when, indeed, the roads are watered, as about London, there is no doubt but a great quantity of that dirt may be removed, which in a few hours of scorching sun would be again converted into a body of dust.

If it should be objected that the Machine is too large, and that a smaller one, which might pass over half the space of ground that this does, and might be worked by two horses, would be better; I must beg leave to answer, that, in my opinion, with a less one there would be much labour to little purpose;

purpose; because this Machine, which passes over a space of about six feet and a half, will not, in some places, when the roads are very wet and very deep, leave more than three feet clear, the mud on each side falling in and filling up, to a considerable extent, the space already passed over. It must therefore be obvious, that, under similar circumstances, the track of a smaller one would almost instantly be obliterated.

Testimonials.

I am so anxious that the Society should have ample satisfaction on this head, that I should be happy if they would, before finally determining on the utility of this Machine, condescend to make some inquiries in this part of the

the country, where it has been publicly tried.

I can however mention, with some pleasure, that several gentlemen, acting as commissioners of the roads, have honoured me with their attendance during various experiments; and, having witnessed the very powerful effects of the Machine, they have given it their public approbation at the last monthly meeting, when the following entry was made in their minute-book.

"At a meeting of trustees of the London and Bath roads, held at the Globe Inn, Newbury, on Monday, the 21st of February, 1803;

PRESENT,

James Croft, Esq.
Frederic Cowslad, Esq.
Rev. Thomas Best
Mr Richard Baily
Mr Thomas Clark
Mr John Baily
Mr Joseph Tanner
Mr Thomas Pocock

"RESOLVED,

"RESOLVED,

"That the Machine, invented by Dr Winterbottom, for scraping off Mud from turnpike-roads, will be of public utility, and save considerable expense of labour."

After this public testimony in its favour, I might perhaps be excused from producing the certificates of a few individuals: it will, notwithstanding, be necessary to give some estimate of the probable saving to be expected from its use.

In all trials made previous to the 21st of February, the Machine had been worked upon no measured extent of ground; but the general effects were such, that several persons of great experience in the management of roads rated the daily work of one Machine only, as equal to the labour of fifty or seventy

seventy men; fifty being the lowest estimate ever named.

I had, a few days ago, directed some work to be done by measure; and I can now state it as the opinion of two very competent judges, that one Machine will clear three miles in a day, twenty feet wide, (consisting of four lengths, and making the day's work twelve miles,) which is considerably more than one hundred and twenty men can do in a day.

	£	s.	d.
One hundred and twenty men, at 2s. a day . .	12	0	0
Four horses and two men can here be hired to work the Machine for the day, at	1	5	0
Difference	£10	15	0

At a distance from London, where carriages run principally in the centre of the road, the chief business in the management of it consists in keeping the sides clear and open; one Machine may therefore be occasionally employed in

in out-side work only, that is, may go six miles and return, (making twelve miles, as just mentioned,) with the saving already given.

Whatever surprise these calculations may occasion, the Society will perhaps be satisfied that I have not over-rated them, when I produce the result of a fair experiment made on the 25th of February, in the presence of four trustees, (Frederic Page, Esq. Francis Page, Esq. Mr Thomas Clark, and Mr John Baily,) and others, by which it appears that two miles by measure, on the road to Reading, were cleared from mud, to the extent of eighteen or twenty feet wide, by two Machines, in the space of two hours and a half by the watch; and the work was judged to be equal to the labour of more than eighty men in a day.

The success of this experiment was so satisfactory to the above-named trustees, for I was not present on the occasion, that they directed, without my knowledge, the remainder of our district on this road, extending seven miles, to be cleared in the same manner; and I can now declare, with some degree of pleasure, that this was actually completed by two Machines in one day, viz. on the following day, the 26th of February. Of this day's work I have repeatedly heard it affirmed, by an experienced surveyor, that it could not have been done in one day by four hundred men.

I confess that I am myself unable, from the want of practical knowledge on this subject, to form a comparative estimate between the work done by this Machine and by hand: I have therefore sought for information from persons

of

of respectable characters, who have been surveyors or renters of roads for many years; and I have been assured, as well by those who were present at the experiments, as by others who examined the roads afterwards, that it would require sixty men a mile, to do the work in one day which a single Machine will accomplish at four lengths; and it has been already shewn that three miles can, without difficulty, be cleared in a day: one Machine will therefore do the work of one hundred and eighty men. But I have taken the average at only two thirds of this estimate, viz. at forty men per mile, instead of sixty, being more willing that the power of the Machine should at present be under-rated, than that the public should be deceived or disappointed concerning it.

The trustees of the London and Bath roads, being desirous of having these two Machines, which had been constructed on my account and under my own inspection, for making the experiments, I have consented to dispose of them; and, as far as I am now able to judge, the price of a Machine complete will be about ten guineas.

Finally, I must beg leave to advise those who are inclined to make a trial of this Machine, to be careful whom they intend to employ in the construction of it; for I can assure them that it is not sufficient to attend only to the form of the model, but it is absolutely necessary that the different parts, and especially the two braces behind, should be firmly put together; otherwise it will be impossible for it to withstand the force that must sometimes be exerted upon it by four, or perhaps

by

by six, horses. The scraper may be made of beech or elm, &c. but the other parts ought to be made of ash; and I must particularly recommend these materials to be well seasoned. All which circumstances were minutely attended to in the two Machines which were made for me by Mr Joseph Moss, of Greenham, near Newbury.

Certificates from Mr George Goddard, Greenham, near Newbury, Mr Francis Page, Mr Frederic Page, Mr John Baily, and Mr Thomas Clark, accompanied the above paper; stating, that, on the 25th of February last, two miles had been cleared in two hours and a half by two of Dr Winterbottom's Machines.

REFERENCE

TO THE

Engraving of Dr Winterbottom's Machine

For clearing roads from mud.

Plate IIII.

Figure, No 8, A A. — Two pieces of ash-timber, forming, at one extremity, a pair of shafts, B B.

C D E. — Three transverse braces, to secure firmly the timbers above-mentioned.

F. — The iron plate, or front of the scraper, fixed within the braces C D, at an angle of thirty degrees, extending on the farther side two feet, and on the nearer side one foot and a half, beyond the timbers.

G. — An iron chain, one end of which is fastened to the outside of the timber A; the other end of the chain may be moved nearer to, or farther from, that end of the scraper which deposits the mud, by means of notches in the iron muzzle H, fixed to the scraper,

and

and which regulates the draught of the horses attached to the ring at G.

K. — The pole, or handle, to be made fifteen feet long, which passes through the strong holdfasts in the braces CD. This pole acts as a lever, as the scraper may be raised or sunk by it, at pleasure. The person who holds it may direct the scraper in its proper line, and assist it in overcoming any obstacles it may meet with in its way, or in giving it additional pressure where necessary.

II, — Show the two parts of the Machine which form the feet or sledge-part of the Machine, on which it slides when reversed, and which enable it to be removed from place to place, when the scraper is not in use. These feet are strongly fixed to the timbers AA, and strengthened by a transverse brace betwixt them.

L, — Is the iron chain, or back-band, which lies upon the cart-saddle of the horse in the shafts, and which supports the shafts.

Figure, No 9 shows, on an enlarged scale, the iron work, fixed on the outside of the shafts, to which the chain and horse are attached.

Figure, No 10 describes, in a small extent, the track usually made by the scraper in a large way,

way, in four rows, commencing at the arrow-mark in the track, No 1; returning, after it has gone any length required, by the track, No 2; proceeding again by the track, No 3, and forcing the mud, collected by the tracks, No 1 and 3, to the right side of the road; and, on its return by the track, No 4, depositing the mud of the tracks No 2 and 4 on the left side of the road, as is more fully described in the preceding account; and thus clearing from mud a breadth of road twenty feet wide, by four passages of the Machine.

THE END.

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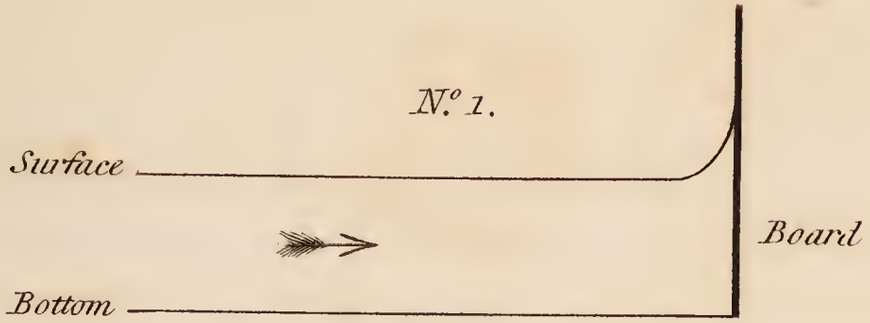
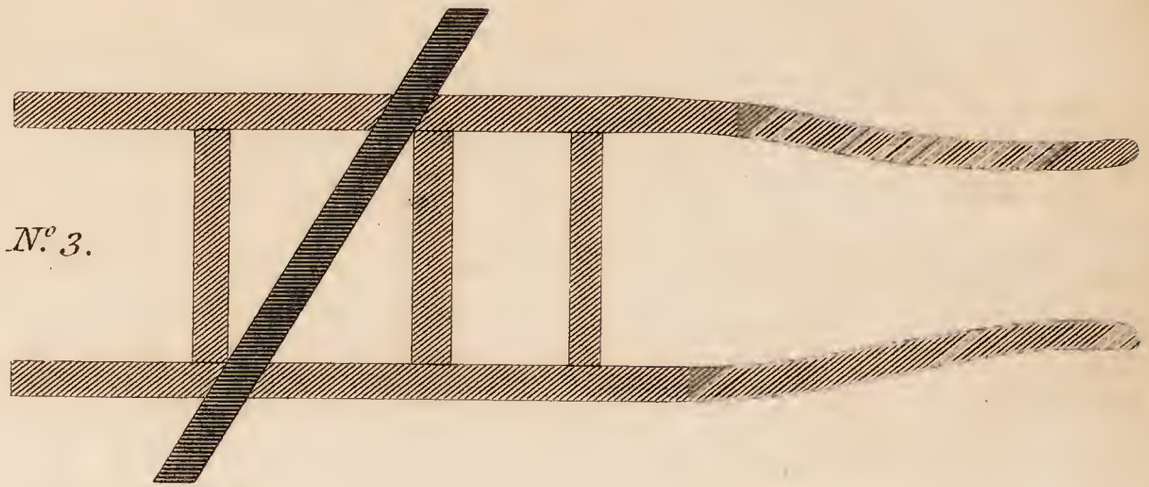
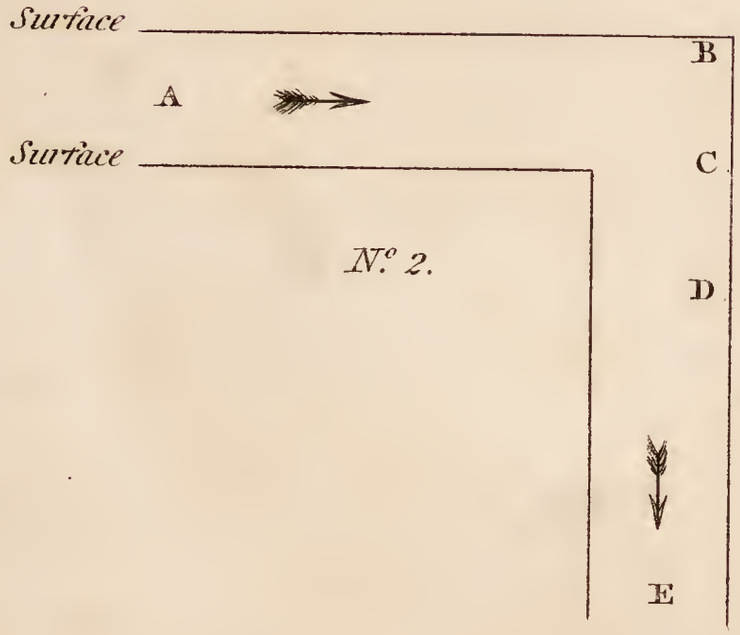
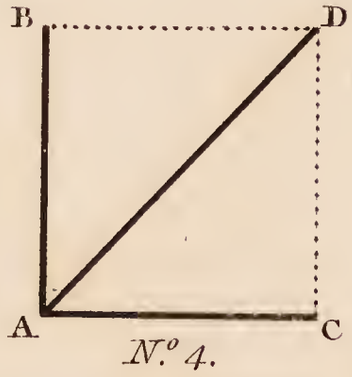
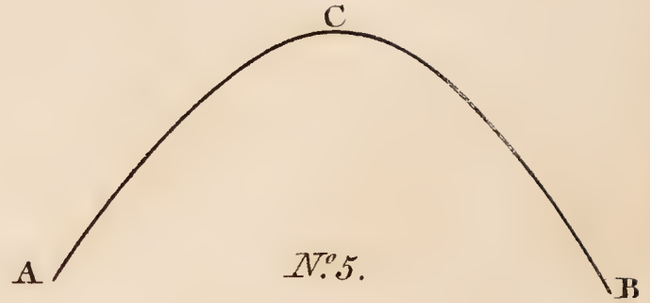


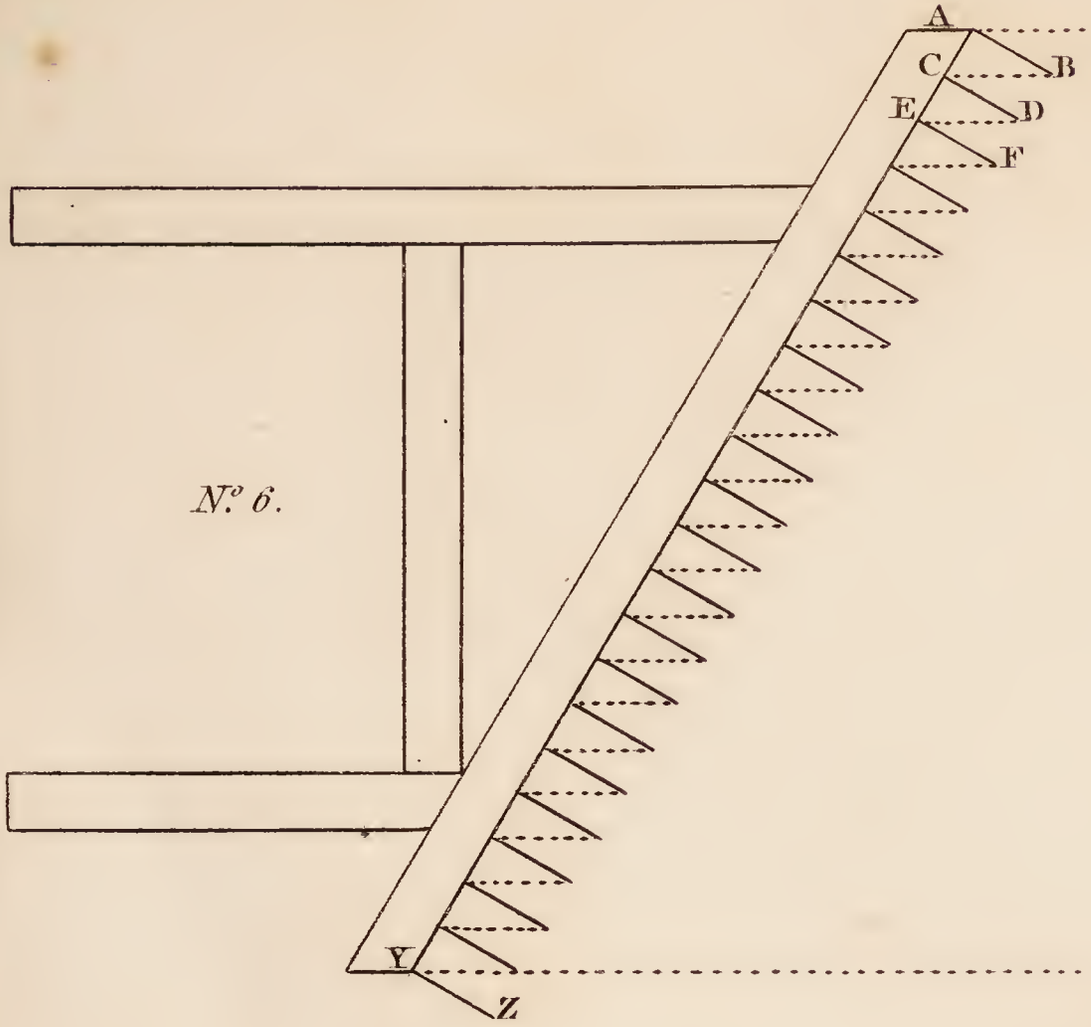








S.Porter sculp.

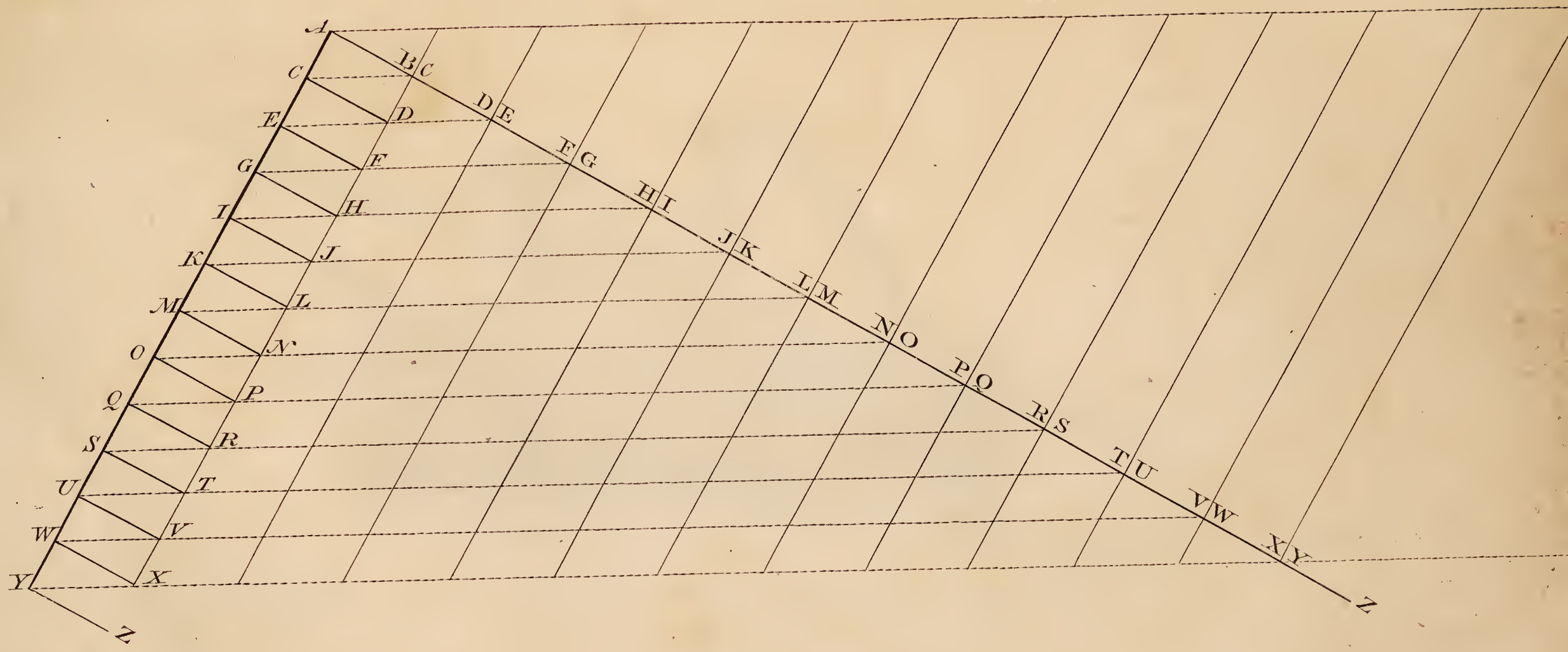


N.º 6.

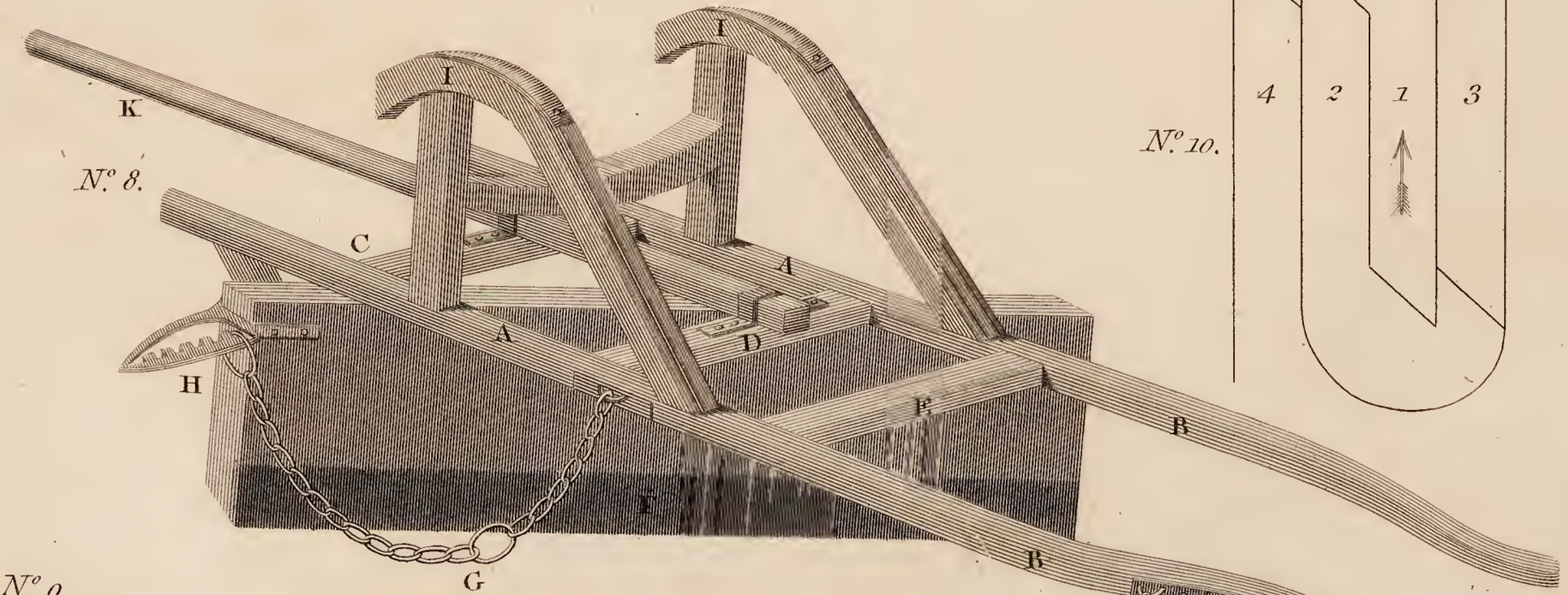
N.º 7.

S.Porter sculp.

FIGURE Nº6. enlarged



Operation of the Machine compared with Archimedes's Screw-Engine



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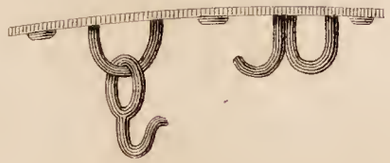

N.º 9.

N.º 10.

Scale of Feet.

7 14

S.Porter sculp.